PATENT SPECIFICATION 1,080,217

DRAWINGS ATTACHED.

1,080,217

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COMPLETE SPECIFICATION.

Improvements in and relating to the Production of Concrete Articles.

We, MAXIME JEAN ROUVIN, PAUL FERNAND ROUVIN and PHILIPPE EDMOND ROUVIN, all French citizens, of 11, avenue Général Sarrail-LUNEL (Hérault), France, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to a process of [mass] producing moulded concrete bodies having cylindrical or prismatic forms.

It is known that in order to make cylindrical bodies in concrete it is necessary, as in foundry work, to use moulds having cores into which moulds the concrete is poured and allowed to harden, and from which it is then withdrawn. This means that the process consists of three operations which have to be carried out in an apparatus consisting of a mould having a more or less complex form according to the concrete product to be manufactured.

It can thus be seen that production takes a long time, as the operations of concrete pouring and hardening have conflicting requirements. If rapid positioning and pouring are required it is necessary to use very fluid concrete, but it is then impossible to strip the pieces immediately and the mould can not therefore be re-used until the concrete has hardened. For this reason, a great number of moulds are required to ensure large scale production.

If large scale industrial production is desired without the use of a considerable number of moulds it is obviously necessary to reduce the time required for the above-mentioned three operations, and more particularly the hardening one, to a minimum.

The problem of obtaining rapid hardening becomes all the more important if the pieces to be manufactured require very expensive moulds, as is particularly the case for large pieces which cannot generally be stripped or withdrawn from the mould immediately because of the difficulty in making a large piece retain its shape, and the impossibility of moving it without damage. It is indeed possible to shorten the hardening time sufficiently to allow the product being made to be stripped from the mould and moved, by using such expedients as vibration, tamping, compression, centrifuging, etc., but such means cannot always be used, especially in the above mentioned case.

It is the object of the invention to overcome the above mentioned difficulties by using a method of continuous manufacture in which the three operations, pouring the concrete and hardening and stripping the product from the mould, are carried out simultaneously and in a single mould.

According to the invention a process for the manufacture of hollow concrete bodies of cylindrical or prismatic form comprises the steps of:

the introduction of a fluid concrete mix into a horizontal mould formed as a die and shaped so as to define the lateral cross section of the finished moulded product and comprising one or more stationary internal cores which form the internal spaces of said product;

the compression of the mixture in the said mould by means of a ram, actuated by means of a piston reciprocable in a hydraulic cylinder, such that at each forward stroke, the said piston compresses the said mixture and forces it towards the outlet of the mould whereas at each return stroke it allows a certain quantity of concrete to enter the mould;

treatment of the concrete, during its passage through mould, by vacuum created

[*Price 4s. 6d.*]

Price 75p

by means of a vacuum pump, which vacuum creates a suction on a portion of the exterior of the mould the sides of which are perforated for this purpose, and also in the interior of each of the fixed cores the sides of which are also perforated, with the object of compacting the concrete, in order to accelerate its drying so as to give it a sufficient rigidity for its extrusion without deformation;

the assisting of the sliding of the concrete by means of guides fixed to the ram or actuated by it and running, in some cases, the length of the sides of the fixed cores and in other cases the length of the internal sides of the mould;

the reception of the extruded product and its support by known carriage means; and

the cutting of the product, after its setting, into desired lengths by known means.

A further object of the invention is the provision of an apparatus to carry out the said process, comprising: a hydraulic cylinder with a reciprocable piston;

a stationary metallic mould formed as a die and shaped so as to define the lateral cross section of the finished moulded product;

stationary internal cores defining the empty spaces to be formed in said moulded product;

a ram adapted for longitudinal movement within said die and driven by the piston of said cylinder;

a hopper opening into said mould through which a certain quantity of fluid concrete slurry is introduced in to the said mould at each stroke of the ram;

a peripherally extending vacuum chamber in longitudinally spaced relationship to the hopper and surrounding the die, within which chamber the side walls of the die are perforated;

a corresponding vacuum chamber provided inside each stationary core, the walls of which are also perforated within the chamber;

a vacuum pump, in fluid connection with and adapted to create a vacuum in said chambers; and

a conveyor which receives the moulded product as it leaves the mould and which carries it to a cutting point where it is cut into lengths by a cutting device.

Preferably the apparatus has a series of additional movable cores driven by the ram and placed round the stationary cores in order to form cavities in the parts of the product around the space or spaces formed by the said stationary cores.

Preferably a number of the movable guides are set at the angles of the mould and inside it and extend the length of the mould.

One or more movable guides are preferably also set longitudinally in the central part of the mould, in contact with a core and extending the length thereof.

A specific embodiment of the invention will now be described with reference to the accompanying drawings in which:

Figures 1—4 show transversal sections which can be given to moulded products in accordance with the process which is the object of the invention.

Figure 5 shows a particular section obtained according to said process.

Figure 6 is a diagrammatic vertical section through an apparatus for carrying out the process, and

Figure 7 shows, in perspective, the placing of various cores and filler-blocks in the mould.

Referring to Figure 6, the process is carried out by means of an apparatus comprising a mould 20, mounted on a frame 19, in to which concrete is fed by gravity from a hopper 22 through a transversely directed orifice 21, positioned adjacent one of the ends of the mould. One or two hollow fixed cores 23 are secured to the frame 19 and extend longitudinally inside the mould 20, being arranged so as to form a smoke stack having a section such as shown in Figure 1 or Figure 3 or such as shown in Figures 2 and 4. The concrete is forced towards the other end of the mould by the forward stroke of a reciprocating ram 17, which slides inside the mould, the ram 17 being mounted by means of connecting rods 18 on a piston 16 of a hydraulic cylinder 15. The ram closes the orifice at the start of its forward stroke and opens the orifice on each return stroke to allow a charge of concrete to enter the mould.

A peripheral vacuum chamber 24, situated a certain distance from the orifice 21 for the admission of liquid concrete into the mould 20, is secured in a air-tight manner to the outside walls of the mould 20 and in addition the interior of each of the fixed cores 23 is formed with a vacuum chamber 24^1. The sides of the mould 20 and those of each of the cores 23 are pierced by holes 25 and 25^1 respectively in the portions of the sides within the said chambers, which chambers are connected by passages 26 and 26^1 to a vacuum pump (not shown).

In order to allow gravity feed of the concrete from the hopper 22 through the orifice 21 into the mould 20, very fluid concrete is used, and during its passage through the mould the concrete is subjected to suction caused by the vacuum which removes excess water from the product. Hardening occurs owing to the pressure of the ram on the concrete and the vacuum applied to the walls of the mould to remove excess moisture, and the moulded elements are then stripped from the mould.

At the outlet of mould 20 a roller conveyor 27 is located on to which the moulded product 28 is pushed under impulsion from the ram 17.

The process as described above gives excellent results in the manufacture of moulded elements of the type shown in Figures 1 and 2, namely those having full walls of constant thickness as in the case of tubes 1 with a round or square section (Fig. 1) or hollow elements 2, (Fig. 2) with an interior dividing wall 3 of the same thickness as the outside wall.

However, if the process is used in this simple manner it does not give perfect results in the case of more complex products such as the hollow element 4 (Fig. 3) which has cavities 5 in the outer wall, or hollow element 6 (Fig. 4) having walls of different thicknesses such as the inner wall 7. In these cases the stripping operation, i.e. the passage of the concrete out of the mould, possibly may not occur very evenly. The concrete may come out more quickly at certain places and in consequence the product breaks when it comes out of the mould. It may not even have the interior wall 7, because this is thinner and may not withstand the frictional forces tending to break the surface of the wall during stripping of the concrete from the mould.

We have established that these phenomena are due to the variation of adherence of the concrete to the mould from one part to another of the section, and to variations in resistance at various parts of the section when the concrete emerges. We have been able to ascertain four main causes for these variations in adherence and in resistance at the exit. These causes are as follows:

(2) The general shape of the mould; the condition of the mould and its various cores;

(2) The impossibility of positioning cavities with absolute regularity in the case of walls with cavities;

(3) The differences in thickness of walls, the thinner being the walls the greater being the effect of friction;

(4) The difference in the surface area between the internal and external sections.

In order to obviate these variations in adherence which affect the product adversely when it comes out of the mould, it has been found necessary to make the following additions to the apparatus:

(1) Special care is taken when the mould and cores are made to ensure that they have a very smooth finish.

(2) Where products whose walls have internal cavities are to be made, the disruptive effect of the cores forming the cavities is minimised by fixing the ends of the cores to sliding ram. When the latter is pushed forward they then move forward with the concrete and at roughly the same speed as the latter, thus minimising friction.

(3) Part of the excess friction on the thin walls is eliminated by using a sheet or filling block which is also fixed to the ram and thus moves forward with the concrete, the size of the filling block depending on the degree of excess friction.

(4) Finally, to eliminate cause 4, the frictional drag on the exterior surface area of the product is lessened in order to balance it against the frictional drag on the internal surface perimeter of the internal section. Sheet or profiled elements or filling blocks are placed in the mould and fixed to the ram with the aim of eliminating the friction between the concrete and the mould in the areas where they are placed, when pressure is applied.

The position and size of said filling blocks depends on the section of the product and it has been found that such filling blocks 9 (Fig. 4) should generally be placed in the angles.

All these movable filling blocks or cores may be fixed to the ram, alternatively they may be mounted on a separate plate which is subjected to the action of the ram.

This apparatus is meant to manufacture smoke stacks such as that shown in Figure 5. This type of pine 10 has cavities 11 in its outer wall and an intermediary interior wall 12 providing two pipes, 13 and 14.

An embodiment of such a modified apparatus is illustrated in Figure 7 which shows the arrangement inside mould 20, of the cores and filling blocks, which in this case are attached directly to the ram.

The mould 20 and the stationary cores 23 are shown by dotted lines for clarity in the drawing, in which can be seen in continuous lines the cores 29 which form the cavities 11 of the pipe, the filling blocks 9 formed by corner pieces placed in the angles of the mould and the filling block 8, which ensures that the wall 12 slides smoothly.

The ram 17 may also be fitted with channels 30 to provide a pathway for round tie rods which pass into the mould with the concrete and serve as reinforcement.

It can easily be understood that all the cores may be round, square, rectangular or of any other section.

WHAT WE CLAIM IS:—

1. A process for the manufacture of hollow concrete bodies of cylindrical or prismatic form comprising the steps of:

the introduction of a fluid concrete mix into a horizontal mould formed as a die and shaped so as to define the lateral cross section of the finished moulded product and comprising one or more stationary internal cores which form the internal spaces of said product;

the compression of the mixture in said mould by means of a ram, actuated by means of a piston reciprocable in a hydraulic cylinder, such that at each forward stroke, the said piston compresses the said mixture

and forces it towards the outlet of the mould whereas at each return stroke it allows a certain quantity of concrete to enter the mould;

treatment of the concrete, during its passage through the mould, by vacuum created by means of a vacuum pump, which vacuum creates a suction on a portion of the exterior of the mould the sides of which are perforated for this pjurpose, and also in the interior of each of the fixed cores the sides of which are also perforated, with the object of compacting the concrete, in order to accelerate its drying so as to give it a sufficient rigidity for its extrusion without deformation;

the assisting of the sliding of the concrete by means of guides fixed to the ram or actuated by it and running, in some cases, the length of the sides of the fixed cores, and in other cases the length of the internal sides of the mould;

the reception of the extruded product and its support by known carriage means; and

the cutting of the product, after its setting, into desired lengths by known means.

2. A process according to claim 1, wherein in order to obtain moulded products having a cavitied wall structure surrounding the spaces formed by the fixed cores, movable cores are arranged longitudinally around said fixed cores and are secured to the ram or are actuated by it in order to prevent any disintegration of the concrete arising from possible adherence to the fixed sides of the mould.

3. An apparatus for carrying out the process according to claim 1 comprising: a frame, a hydraulic cylinder with a reciprocable piston mounted within the frame;

a stationary metallic mould formed as a die and shaped so as to define the lateral cross section of the finished moulded product;

stationary internal cores also secured to the frame defining the empty spaces to be formed in said moulded product;

a ram adapted for longitudinal movement within said die and driven by the piston of said cylinder;

a hopper opening into said mould through which a certain quantity of fluid concrete mix is introduced in to said mould at each stroke of the ram;

a peripherally extending vacuum chamber in longitudinally spaced relationship to the hopper and surrounding the die, within which chamber the side walls of the die are perforated;

a corresponding vacuum chamber provided inside each stationary core, the walls of which are also perforated within the chamber;

a vacuum pump, in fluid connection with and adapted to create a vacuum in said chambers; and

a conveyor which receives the moulded product as it leaves the mould and which carries it to a cutting point where it is cut into lengths by a cutting device.

4. An apparatus according to claim 3 comprising a plurality of longitudinally extending guides, formed as movable profiled elements, secured to the ram or actuated by it.

5. An apparatus according to either one of claims 3 and 4, comprising one or more movable cores secured to or moved by the ram and positioned around the stationary cores so as to form cavities in the walls of the product which surround the space or spaces formed by the said stationary cores.

6. An apparatus according to either one of claims 4 and 5, comprising a number of movable profiled elements secured to or moved by the ram, positioned at, and extending the length of, the intersections of the sides of the mould, and located inside the latter.

7. An apparatus according to any of claims 3 to 6 comprising means for introducing tie rods into the mould with the concrete.

8. A process of producing concrete articles substantially as described.

9. An apparatus for producing concrete articles by moulding, substantially as described with reference to Figure 6 and 7 of the accompanying drawings.

10. Concrete articles when made by the process claimed in any of claims 1, 2 and 8 or by the apparatus in any of claims 3—7 and 9.

For the Applicants,
CARPMAELS & RANSFORD,
Chartered Patent Agents,
24 Southampton Buildings,
Chancery Lane,
London, W.C.2.

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2 SHEETS *This drawing is a reproduction of the Original on a reduced scale*

Sheet 1

Fig.1

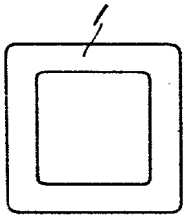


Fig.2

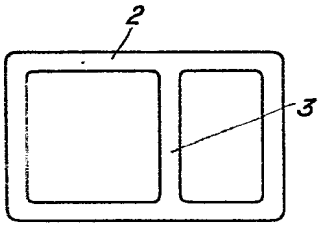


Fig.3

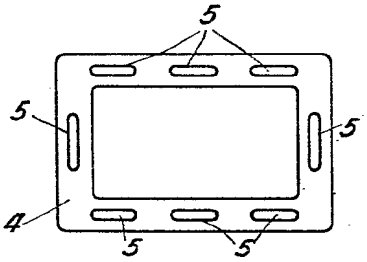


Fig.4

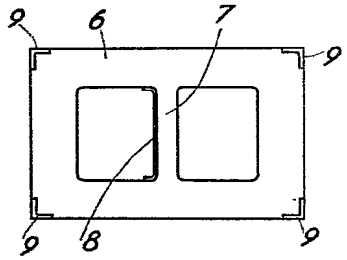


Fig.5

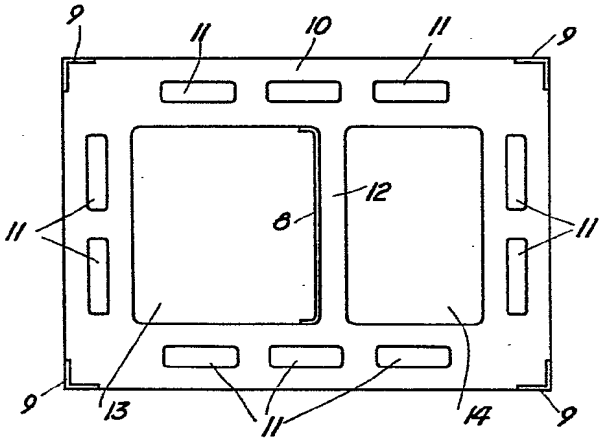
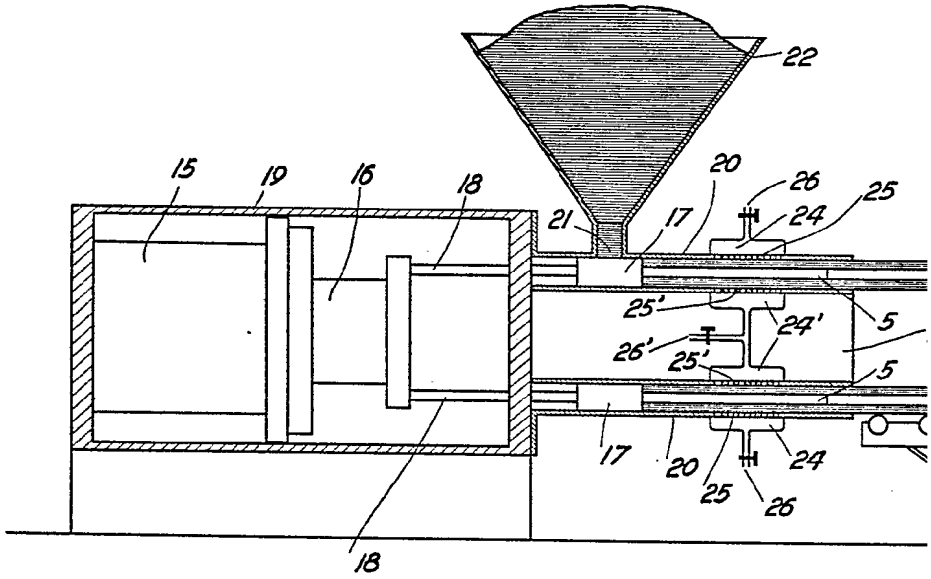
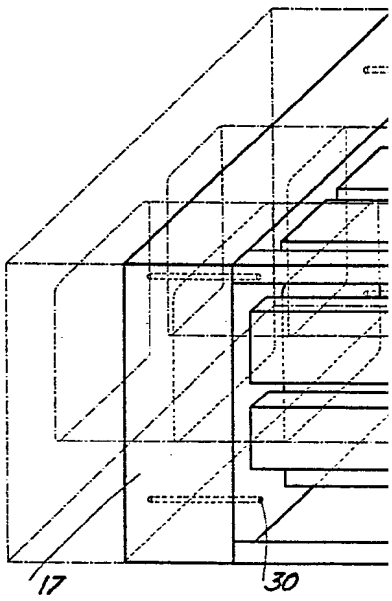


Fig. 6





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Sheet 2

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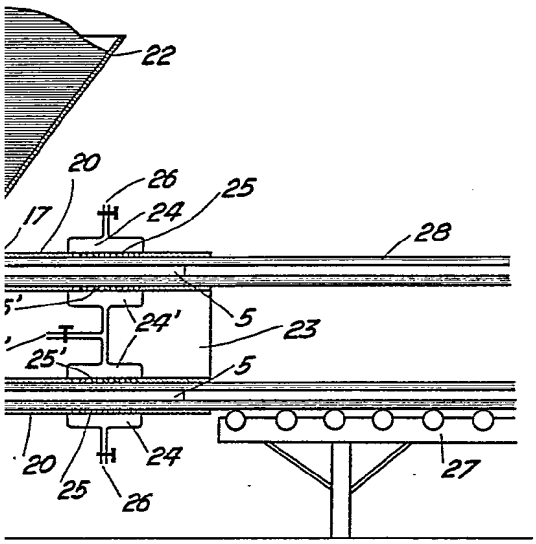

Fig. 7

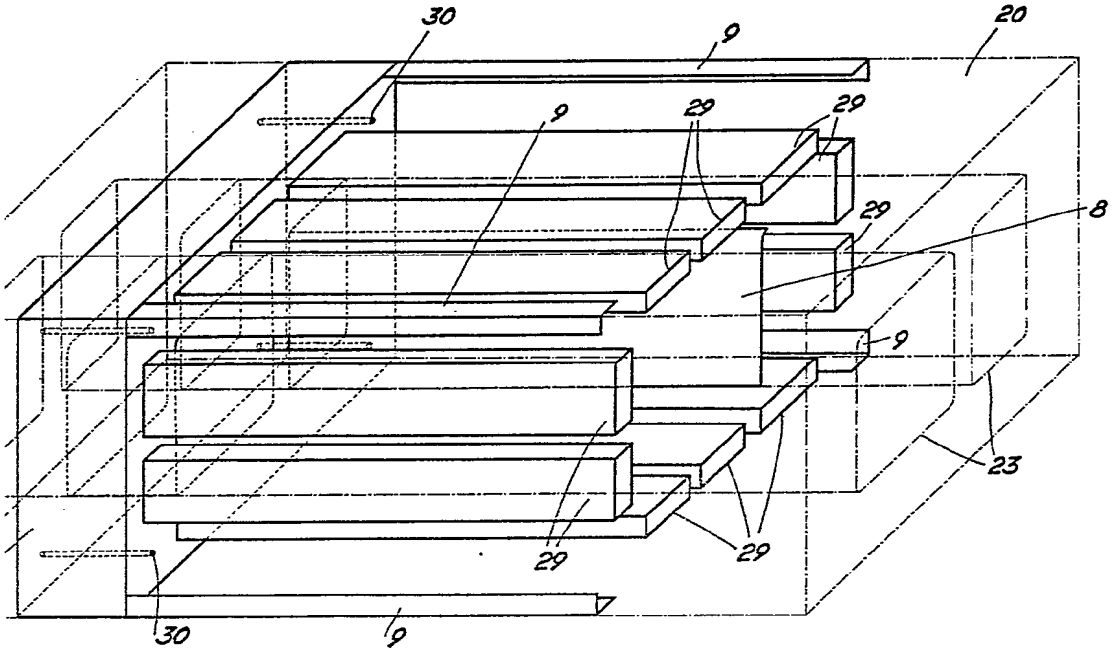

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Fig.6

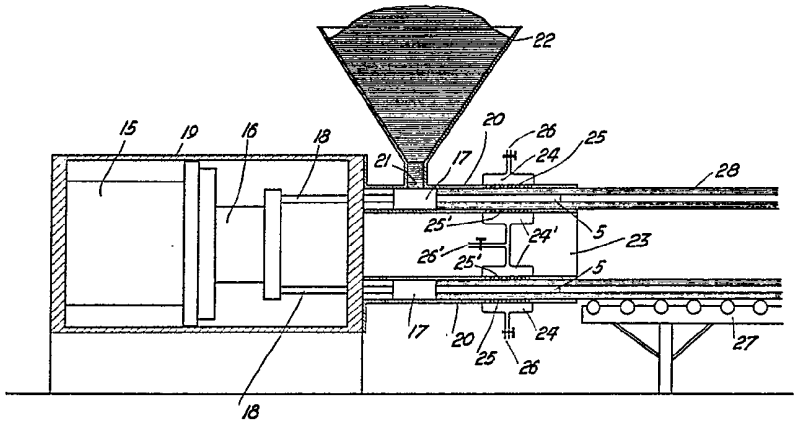

Fig.7